KOKAI PATENT APPLICATION NO. HEI 4-48515

METHOD FOR PRODUCTION OF TRANSPARENT CONDUCTIVE FILM

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Translation of KOKAI PATENT APPLICATION NO. HEI 4-48515

METHOD FOR PRODUCTION OF TRANSPARENT CONDUCTIVE FILM

[*Tohmei dohdensei fuirumuno seizoh houhoh*]

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[There are no amendments to this patent.]

[*Translator's note: Many numbers were barely legible in the source document. Best guesses have been made.*]

Specification

1. Title of invention

Production of transparent conductive film

2. Claim of the invention

(1) In the production of a transparent conductive film where a transparent conductive film is formed on a polyester type film by means of deposition, a method of producing a transparent conductive film characterized by the fact that a water repellent polymer is deposited onto the surface of either the film or the transparent conductive film or both.

(2) In the production of a transparent conductive film where a transparent conductive film is formed on a polyester type film by means of deposition, a method of producing a transparent conductive film characterized by the fact that a water repellent organic gas is adsorbed onto the surface of either the film or the transparent conductive film or both by means of plasma

polymerization.

3. Detailed description of the invention

(Field of industrial application)

The present invention pertains to a method of producing a transparent conductive film used for EL.

(Prior art)

EL display is suitable for automobile displays and liquid crystal backlighting.

Among EL displays, the dispersing type has a structure where a transparent conductive film, light-emitting layer, dielectric pressure resistant layer, and rear electrode layer are laminated and the entire laminate is covered with a protective film. And light emission is achieved through application of AC voltage between the transparent electrode and rear electrode.

For the aforementioned transparent film, polyester, polyether sulfone, polystyrene, polyether ketone, etc. are used and the cost of polyester is low and is widely used. Furthermore, for the light-emitting layer, a material produced by dispersing ZnS and Cu in a binder such as cyanoethylene is used. For the dielectric pressure resistant layer laminated onto the aforementioned light-emitting layer, a material produced by dispersing a $BaTiO_3$ type powder in a binder such as cyanoethylene is used.

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(Problems to be solved by the invention)

However, moisture absorption and water absorption of polyesters used for transparent films are high and furthermore, each material used in light-emitting layer or dielectric pressure resistant layer is likely to absorb moisture and the moisture is one of the causes of reduction in luminous intensity of the light-emitting layer and the intensity of light is easily reduced.

In order to solve the aforementioned problem, a method where an ethylene vinyl alcohol copolymer or epoxy acrylate resin, trifluoromonochloroethylene, vinylidene chloride, etc. is dissolved in a solvent and coated onto the surface of a polyester film using a wet coating method

such as gravure coating, roll coating, or dip coating is known. Furthermore, a method where an inorganic material such as SiO_2, TiO_2 and Al_2O_3 is deposited by means of vacuum deposition is known. However, automation of the former wet coating method is difficult, and when the transparent conductive film is formed by means of deposition, etc., production cost is increased. Furthermore, in the latter case, the effect cannot be achieved unless the film thickness is at least 1000 Å, but the film becomes hard with increased thickness and cracks are likely to form.

The purpose of the present invention is to provide a method of producing a transparent conductive film that provides a solution to improve the problems mentioned above and provides a lower reduction in luminous intensity due to moisture when the film is used for EL, etc. and makes automated production of the film possible to achieve a cost reduction.

(Means to solve the problem)

In order to achieve the aforementioned purpose of the present invention, the invention described in claim 1 is to provide a method of producing a transparent conductive film characterized by the fact that a water repellent polymer is deposited onto the surface of either the film or the transparent conductive film or both in the manufacture of a transparent conductive film where a transparent conductive film is formed on a polyester type film by means of deposition.

Furthermore, the invention described in claim 2 is to provide a method of producing a transparent conductive film characterized by the fact that a water repellent organic gas is adsorbed onto the surface of either the film or the transparent conductive film or both by means of plasma polymerization in the invention described in claim 1.

(Work of the invention)

When a water repellent polymer or an organic gas is adsorbed to the surface of a film or the surface of a transparent conductive film, reduction in luminous intensity as a result of permeation of moisture into the light-emitting layer based on the polymer or organic material when the aforementioned transparent conductive film is used for EL display can be prevented.

Furthermore, the polymer or organic gas is adsorbed by means of deposition or plasma

polymerization, fabrication is made possible in the same tank for formation of the transparent conductive film and automation is made possible, resulting in a cost reduction.

(Working examples)

The present invention is explained in further detail with the working examples below.

First, as shown in Fig. 1, transparent film 2 is supplied to vacuum tank 3 from supply roll 1. The vacuum tank is retained at a pre-determined degree of vacuum by vacuum pumps 4, 5, and 6. For the aforementioned transparent film, a polyester type film such as polyethylene terephthalate or polyethylene 2,6-naphthalate can be used.

Inside first chamber 7, deposition crucible 8 is heated and polymer 9 contained in it is vaporized to deposit polymer 9 onto the surface of transparent film 2. Or an organic gas is introduced to the first chamber 7 through gas induction port 10 to adsorb the organic material on the film. For the aforementioned polymer 9, water repellent polyethylene, polyphenylene sulfide, polyparaxylene, etc. are used. Furthermore, for the aforementioned organic gas, water repellent acetylene, ethylene, methane, ethane, benzene, hexachlorobenzene, styrene, tetrachloroethylene, cyclohexane, ethylene oxide, acrylic acid, propionic acid, vinyl acetate, methyl acrylate, aromatic silane compounds such as hexamethylene disilane and $C_6H_5SiO_3$, siloxanes such as hexamethyldisiloxane and divinyl tetramethyldisiloxane, etc. can be mentioned.

After forming a water repellent layer comprising polymer 9 or organic material onto the surface of the aforementioned transparent film 2, deposition crucible 12 is heated inside the second chamber 11 so as to vaporize metal oxide 13 such as indium oxide or tin oxide contained in it, and the vapor is vacuum deposited onto the surface of the water repellent layer to form a transparent conductive film. In this case, an appropriate gas is introduced from the gas induction port, as needed.

After forming the aforementioned transparent conductive film, the transparent film 2 is transferred to the third chamber 15 and either deposition crucible 16 is heated to vaporize polymer 17 contained in it or an organic gas is introduced to the third chamber 15 through gas induction line

18 to form a water repellent layer comprising a polymer or organic material onto the surface of the transparent conductive film.

After formation of the water repellent layer onto the surface of the aforementioned transparent conductive film, a material produced by dispersing ZnS and Cu in a binder such as cyanoethylene is vacuum deposited or ion-plated to form a light-emitting layer.

After formation of the aforementioned light-emitting layer, a material produced by dispersing a $BaTiO_3$ type powder in a binder such as cyanoethylene is deposited onto the surface of the light-emitting layer to form a dielectric pressure resistant layer.

After formation of the aforementioned dielectric pressure resistant layer, an Al foil with an absence of moisture permeability is applied to the surface to form a back electrode.

After formation of the aforementioned back electrode, the entire laminate is covered with a protective film comprising trifluorochloroethylene resin.

Furthermore, for the aforementioned working examples and prior art, moisture permeability test was provided. Production conditions used in each working example and prior art are as described below.

Working Example 1)

As shown in Fig. 2, a transparent conductive film 20 comprising ITO with a thickness of 500 Å was laminated onto transparent film 19 consisting of a polyethylene terephthalate film with a thickness of 75 μm by the sputtering method. Then, a plasma treatment was provided in an organic gas atmosphere containing methane gas to form water repellent layer 21 comprising a modified layer of alkyl indium ($(CH_3)_xIn$: x=1-3) or alkyl indium oxide ($[(CH_3)_xIn]_2O$: x=1-3) on the surface of the aforementioned transparent conductive film 20.

Working Example 2)

As shown in Fig. 3, water repellent layer 22 is produced as thermal decomposition is provided for Di-paraxylylene and deposited to form polyparaxylylene in the aforementioned

Working Example 1.

Working Example 3)

As shown in Fig. 4, the transparent film 19 used in Working Example 1 is used and $C_6H_5SiO_3$ is adsorbed on both surfaces to form a thickness of 100 Å by means of plasma polymerization to form the first water repellent layer 23. Then, vacuum deposition of ITO is provided for the entire surface of the aforementioned first water repellent layer 23 to form a thickness of 500 Å and transparent conductive film 24 is laminated. Furthermore, polyphenylene sulfide is used as the sputtering target and vacuum sputtering is performed in a vacuum to produce second water repellent layer 25 comprising polyphenylene sulfide.

Prior art

As shown in Fig. 5, water repellent layer 21 is omitted in the aforementioned Working Example 1.

For the test conditions, each sample was cut to form squares of 2 cm x 2 cm, and 250 squares for each working example, etc. were prepared, dried for 3 hours at a temperature of 100°C, chilled in a desiccator at 20°C; then, stored under an atmosphere of 30°C and humidity of 80% RH for 3 hrs, and the moisture content was measured. The moisture content is the total for 250 pieces and based on the change in weight before and after storage under humidity.

The results obtained are shown in the Table below.

Type	Moisture content (g)
Working Example 1	0.01
Working Example 2	0.01
Working Example 3	0.005
Prior art	0.3

As clearly shown in the table above, moisture permeability is a low of 1/60 to 1/30 in

Working Example 1 to Working Example 3 compared to the prior art example, and improvement in moisture resistance is observed.

(Effect of the invention)

As explained in detail above, according to the method of manufacturing described in claim 1 and claim 2, production of a transparent conductive film having low moisture permeability based on the water repellent layer provided on the surface of the film or the transparent conductive film is possible and it is capable of preventing a reduction in luminous intensity of the light-emitting layer.

Furthermore, production of the water repellent layer is made possible inside the same tank; thus, the aforementioned process can be automated and production cost can be reduced.

4. Brief description of the figures

Fig. 1 is a cross-section view of the device used for production of working example of the present invention, Fig. 2 is a cross-section view of a transparent conductive film produced by the present invention, Fig. 3 and Fig. 4 are cross-section views of transparent conductive films produced in other working examples of the present invention, and Fig. 5 is a cross-section view of a transparent conductive film of the prior art.

Explanation of codes

2, 19: transparent film

3: vacuum tank

9, 17: polymer

20, 24: transparent conductive film

21, 22: water repellent layer

23: first water repellent layer

25: second water repellent layer

Applicant: Hitachi Condenser

Fig. 1

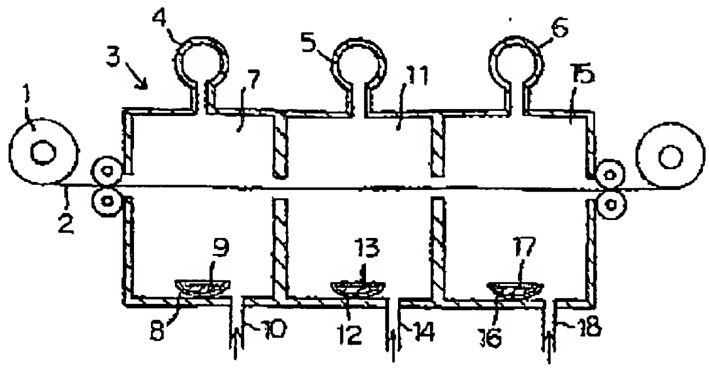

Fig. 2

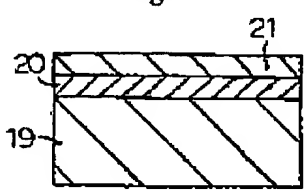

Fig. 3

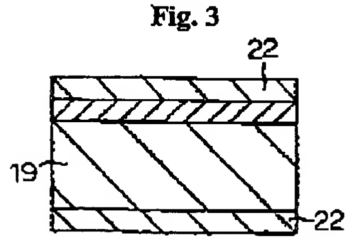

Fig. 4

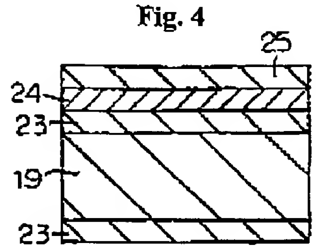

Fig. 5